इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 1305 (1984): Graphite for use in foundry coatings [MTD 14: Foundry]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

Indian Standard

SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

Second Reprint JANUARY 1999

UDC 621.744.527.7 : 666.762.814/.816

© *Copyright* 1984

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3
December 1984

AMENDMENT NO. 1 SEPTEMBER 1987

TO

IS:1305-1984 SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(*Third Revision*)

(*Page* 10, *clause* C-4.1, *line* 1) - Add 'or Table 2' after the word 'Table 1'.

(*Page* 10, *clause* C-4.2, *line* 2) - Substitute 'Table 3' *for* 'Table 2'.

(SMDC 17)

Printed at Printograph, New Delhi (India)

AMENDMENT NO. 2 OCTOBER 1996
TO
IS 1305 : 1984 SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

(*Page* 8, *clause* **B-5.3**) — Substitute the following for the existing:

'**B-5.3 Calculation**

Non-graphitic carbon, percent by mass = $100 \times \dfrac{(M_1 - M_2)}{M} - (A+B)$

where

M_1 = first mass of the beaker and contents,

M_2 = second mass of the beaker and contents,

M = mass in g of the sample taken for test,

A = percent loss on heating (*see* **B-2.1**), and

B = percent petroleum ether soluble matter.'

(MTD 14)

Reprography Unit, BIS New Delhi, India

Indian Standard

SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

Foundry Sectional Committee, SMDC 17

Chairman	*Representing*
Dr S. S. Khanna	National Institute of Foundry & Forge Technology, Ranchi
Members	
Shri M. M. C. Agrawal	Heavy Engineering Corporation Ltd, Ranchi
Shri A. K. Banerjee (*Alternate*)	
Shri S. H. Commissariat	Institute of Indian Foundrymen, Calcutta
Shri R. P. Varshney (*Alternate*)	
Shri K. A. Gandhi	HMT Ltd, Bangalore
Shri H. S. Ramachandra (*Alternate* I)	
Shri A. Shantharam (*Alternate* II)	
Shri P. P. Chopra (*Alternate* III)	
Shri R. M. Gorane	Kirloskar Brothers, Kirloskarvadi
Shri D. M. Dabak (*Alternate*)	
Shri P. L. Jain	National Institute of Foundry & Forge Technology, Ranchi
Shri K. Kishore (*Alternate*)	
Shri L. M. Joshi	DCM Engineering Products, Ropar
Shri K. N. Mehra	Cooper Engineering Ltd, Satara
Shri M. L. Navare	Versatile Equipment Pvt Ltd, Kolhapur
Shri Subhash Kulkarni (*Alternate*)	
Shri N. V. Pandit	M. M. Suri & Associates (P) Ltd, New Delhi
Shri Thomas Paul	Pioneer Equipment Co Pvt Ltd, Vadodara
Shri C. Bhaskaran (*Alternate*)	
Shri G. N. Rao	National Metallurgical Laboratory (CSIR), Jamshedpur
Shri N. R. Nagaraj Rao	Steel Authority of India Ltd (Bhilai Steel Plant), Bhilai
Shri R. R. Saran (*Alternate*)	
Shri T. S. Venkoba Rao	Ennore Foundries Ltd, Madras
Shri K. V. Ramakrishnan (*Alternate*)	

(*Continued on page* 2)

© *Copyright* 1984
BUREAU OF INDIAN STANDARDS
This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
Shri P. P. Rastogi	Steel Authority of India Ltd (Rourkela Steel Plant), Rourkela
Shri S. Chaubey (*Alternate*)	
Shri R. N. Saha	Directorate General of Supplies & Disposals (Inspection Wing), New Delhi
Shri Darbara Singh (*Alternate*)	
Shri U. Sen	Directorate General of Technical Development, New Delhi
Shri Y. H. Raut (*Alternate*)	
Senior Chemist & Metallurgist CLW, Chittaranjan	Ministry of Railways
Chemist & Metallurgist (SF), CLW, Chittaranjan (*Alternate* I)	
Chemist & Metallurgist, NF Railway, New Bongaigaon (*Alternate* II)	
Shri V. P. Shenoy	Tata Engineering & Locomotive Co Ltd, Jamshedpur
Shri A. Bhattacharjee (*Alternate*)	
Shri H. N. Singh	Indian Iron & Steel Co Ltd, Calcutta
Shri R. N. Mukherjee (*Alternate*)	
Shri V. N. Sunderrajan	M. N. Dastur & Co Ltd, Calcutta
Shri S. Thiyagarajan	Southern Alloy Foundries Pvt Ltd, Madras
Shri A. Thangavelu (*Alternate*)	
Shri V. N. Upadhayaya	Federation of Engineering Industries of India, New Delhi
Shri H. L. Bhardwaj (*Alternate*)	
Shri Nand Lal Varma	International Steel Fabricators, Bombay
Shri Rajesh Kumar Varma (*Alternate*)	
Shri K. Raghavendran, Director (Struc & Met)	Director General, ISI (*Ex-officio Member*)

Secretary

Shri S. K. Gupta
Deputy Director (Metals), ISI

Foundry Auxiliary Materials Subcommittee, SMDC 17 : 5

Convener	
Shri P. L. Jain	National Institute of Foundry & Forge Technology, Ranchi
Members	
Shri K. Kishore (*Alternate* to Shri P. L. Jain)	
Shri P. D. Bajoria	J. D. Jones & Co Ltd, Calcutta
Shri H. N. Sen (*Alternate*)	
Shri A. Bhattacharjee	Tata Engineering & Locomotive Co Ltd, Jamshedpur
Shri V. Manninge (*Alternate*)	

(*Continued on page* 11)

Indian Standard

SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

0. FOREWORD

0.1 This Indian Standard (Third Revision) was adopted by the Indian Standards Institution on 31 May 1984, after the draft finalized by the Foundry Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in the year 1958. In its subsequent revisions in 1963 and 1967, the limits for maximum non-graphitic carbon content of the material and its method of determination and a new grade of purer variety of flake graphite were incorporated. In this revision, requirements of synthetic graphite have been included in view of its increasing usage in foundries. Some of the physical characteristics to distinguish between natural graphite and synthetic graphite have been included in Appendix A for information only. Keeping in view of the type of its usage in foundry, the title of the standard has also been modified.

0.3 Foundry coatings are used to prevent fusion of liquid metal with the sand at the mould or core face. They are applied as thin coating by spraying or painting in the form of suspension or by dusting or rubbing as dry powders. Graphite is one of the materials for this purpose.

0.3.1 Good quality graphite when applied on mould or core surfaces does not peel off in flakes and when it dries imparts a smooth surface to the casting.

0.4 This standard keeps in view the manufacturing and trade practices followed in the country in this field.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained

---

*Rules for rounding off numerical values (*revised*).

in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements of natural graphite and synthetic graphite for use as graphite for foundry coatings.

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of graphite for use as foundry coating material, shall be as laid down in IS : 1387-1967*.

3. MANUFACTURE

3.1 The natural graphite shall be manufactured from crystalline quality natural flake graphite, silvery in appearance. Synthetic graphite shall be manufactured from calcined petroleum coke, dark black amorphous in appearance, in the form of the powder and free from gritty particles.

4. GRADES

4.1 Natural graphite shall be of three grades, namely, Grades 1, 2 and 3 as given in Table 1 and synthetic graphite shall be of one grade as given in Table 2.

5. REQUIREMENTS

5.1 The material shall comply with the requirements given in Tables 1 and 2 when tested in accordance with methods given in Appendix B. Reference to the relevant clauses of Appendix B is also given in Tables 1 and 2.

TABLE 1 PHYSICAL REQUIREMENTS OF NATURAL GRAPHITE FOR USE AS FOUNDRY COATING MATERIAL

(*Clauses* 4.1 *and* 5.1)

SL No.	CHARACTERISTIC	REQUIREMENT, PERCENT BY MASS			METHOD OF TEST (REF TO CL NO. IN APPENDIX B)
		Grade 1	Grade 2	Grade 3	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Moisture, *Max*	1·0	1·0	1·0	B-2
ii)	Analysis on dry basis:				
	a) Volatile matter, *Max*	3·0	3·0	3·0	B-3
	b) Ash, *Max*	12	20	30	B-4
	c) Fixed carbon	←——By difference——→			
iii)	Non-graphitic carbon, *Max*	0·5	2·5	2·5	B-5

---

*General requirements for the supply of metallurgical materials (*first revision*).

TABLE 2 REQUIREMENTS OF SYNTHETIC GRAPHITE FOR USE AS FOUNDRY COATING MATERIAL

(*Clauses* 4·1 *and* 5·1)

Sl No.	Characteristic	Requirement, Percent by Mass	Method of Test (Ref to Cl No. in Appendix B)
(1)	(2)	(3)	(4)
i)	Moisture, *Max*	1·0	B-2
ii)	Analysis on dry basis:		
	a) Volatile matter, *Max*	2·0	B-3
	b) Ash, *Max*	3·0	B-4
	c) Fixed carbon	By difference	
iii)	Non-graphitic carbon, *Max*	3·5	B-5

5.2 Compatability — The material shall not separate out when used in the preparation of wet coating particularly water based coatings.

5.3 Fineness — The fineness of all the three grades of natural graphite and synthetic graphite shall conform to the requirement specified in Table 3.

TABLE 3 MINIMUM PERCENTAGE OF MATERIAL TO PASS THROUGH RESPECTIVE SIEVES

Sieve No*	Percent
(1)	(2)
150 µm	100
75 µm	75

**See* IS : 460 (Part 1)-1975 'Specification for test sieves: Part 1 Wire cloth test sieve (*second revision*).

6. SAMPLING

6.1 Representative samples of the material shall be drawn as prescribed in Appendix C.

7. PACKING

7.1 Unless specified otherwise, the material shall be supplied in moisture proof bags or packets, each containing 25 kg.

8. MARKING

8.1 The container shall be clearly marked with the manufacturer's name or trade-mark and the grade of the material.

8.2 BIS Certification Marking

The product may also be marked with Standard Mark.

8.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

APPENDIX A

(*Clause* 0.2)

CHARACTERISTICS TO DISTINGUISH BETWEEN NATURAL GRAPHITE AND SYNTHETIC GRAPHITE

A-1. CHARACTERISTICS

A-1.1 Some characteristics of natural graphite and synthetic graphite are given below for guidance of the users:

Characteristics	*Natural Graphite*	*Synthetic Graphite*
i) Physical appearance	Flaky	Crystalline
ii) Swelling and gas evolution	When powdered natural graphite is heated with a mixture of 1 part of nitric acid and 4 parts of sulphuric acid, it assumes a purple tint. The sample is then washed to restore it to its original colour. The sample is dried and heated to redness, it swells up with a copious gas evolution. Artificial graphite neither swells up nor shows brisk evolution of gas, when tested similarly.	

NOTE — In case of the synthetic graphite is mixed with the natural graphite, it may not be possible to clearly find out the composition of the mixture.

APPENDIX B

(*Clause* 5.1 and *Table* 1)

METHODS OF TEST

B-1. QUALITY OF REAGENTS

B-1.1 Unless specified otherwise, pure chemicals shall be employed in the tests and distilled water (*see* IS : 1070-1960*) shall be used where the use of water as reagent is intended.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the result of analysis.

B-2. DETERMINATION OF MOISTURE

B-2.1 Procedure — Weigh accurately about 5 g of the material in a tared porcelain dish and cover it with a watch-glass. Place the dish in an air-oven maintained at 105±1°C and remove the watch-glass from it. Heat the sample for two hours in the oven and cover the dish with the watch-glass before taking it out of the oven. Cool the dish in a desiccator and weigh. Repeat heating, cooling and weighing to constant weight.

B-2.2 Calculation

$$\text{Moisture, percent} = \frac{A}{B} \times 100$$

where

A = loss in mass in g of the material after heating, and

B = mass in g of the material taken.

B.3. DETERMINATION OF VOLATILE MATTER

B-3.1 Procedure — Introduce in a weighed platinum crucible with tightly fitting lid about one gram of the moisture-free sample. The lid should have a hole, one millimetre in diameter, in the middle to help the escape of volatile matter. Heat the crucible in a muffle furnace maintained at a temperature of 925±25°C for 7 minutes. The bottom of the crucible shall not rest on the muffle floor. Remove the crucible from the muffle after 7 minutes; cool in a desiccator and weigh.

B-3.2 Calculation

$$\text{Volatile matter, percent} = \frac{A}{B} \times 100$$

where

A = loss in mass in g of the moisture-free sample after heating up to 925 ± 25°C, and

B = mass in g of the moisture-free sample taken.

B-4. DETERMINATION OF ASH

B-4.1 Procedure — Weigh accurately about 2 g of the moisture-free material in a tared platinum dish and incinerate till the residue in the crucible is constant in mass. Cool in a desiccator and weigh.

B-4.2 Calculation

$$\text{Ash, percent} = \frac{A}{B} \times 100$$

where

A = mass of ash in g, and
B = mass of the sample taken.

B-5. DETERMINATION OF NON-GRAPHITIC CARBON

B-5.1 Procedure — Weigh accurately about 2 g of the material into a heat-resistant glass beaker fitted with a nickel cover and note the mass of the beaker with the material (M_1). Heat in a furnace at a temperature of $440 \pm 5^\circ$C for 16 hours. Cool the beaker and contents in a desiccator and weigh (M_2).

NOTE — The heating for 16 hours should preferably be done at a stretch. If this is not practicable, it should be done in two equal instalments of 8 hours each, on two successive working days.

B-5.2 Determination of Petroleum Ether Soluble Matter — Weigh accurately about 10 g of the material and extract with petroleum ether (bp 60°C to 80°C) in a Soxhlet apparatus for 2 hours. Filter the petroleum ether extract through a filter paper into a tared flask. Distil off the solvent and remove the last trace of it in vacuum. Cool the flask and weigh to constant weight. Calculate the increase in mass of the flask as percentage of the mass of the material taken for the test.

B-5.3 Calculation

$$\text{Non-graphitic carbon, percent by mass} = 100 \frac{M_1 - M_2}{M} - (A + B)$$

where

M_1 = first mass of the beaker and contents,
M_2 = second mass of the beaker and contents,
M = mass in g of the sample taken for the test,
A = percent loss on heating (*see* **B-2.1**), and
B = percent petroleum ether soluble matter.

AMENDMENT NO. 2 OCTOBER 1996
TO
IS 1305 : 1984 SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

(*Page* 8, *clause* B-5.3) — Substitute the following for the existing:

'**B-5.3 Calculation**

$$\text{Non-graphitic carbon, percent by mass} = 100 \times \frac{(M_1 - M_2)}{M} - (A+B)$$

where

M_1 = first mass of the beaker and contents,

M_2 = second mass of the beaker and contents,

M = mass in g of the sample taken for test,

A = percent loss on heating (*see* B-2.1), and

B = percent petroleum ether soluble matter.'

(MTD 14)

Printed at Printograph, New Delhi (INDIA)

B-4. DETERMINATION OF ASH

B-4.1 Procedure — Weigh accurately about 2 g of the moisture-free material in a tared platinum dish and incinerate till the residue in the crucible is constant in mass. Cool in a desiccator and weigh.

B-4.2 Calculation

$$\text{Ash, percent} = \frac{A}{B} \times 100$$

where

A = mass of ash in g, and
B = mass of the sample taken.

B-5. DETERMINATION OF NON-GRAPHITIC CARBON

B-5.1 Procedure — Weigh accurately about 2 g of the material into a heat-resistant glass beaker fitted with a nickel cover and note the mass of the beaker with the material (M_1). Heat in a furnace at a temperature of 440 ± 5°C for 16 hours. Cool the beaker and contents in a desiccator and weigh (M_2).

NOTE — The heating for 16 hours should preferably be done at a stretch. If this is not practicable, it should be done in two equal instalments of 8 hours each, on two successive working days.

B-5.2 Determination of Petroleum Ether Soluble Matter — Weigh accurately about 10 g of the material and extract with petroleum ether (bp 60°C to 80°C) in a Soxhlet apparatus for 2 hours. Filter the petroleum ether extract through a filter paper into a tared flask. Distil off the solvent and remove the last trace of it in vacuum. Cool the flask and weigh to constant weight. Calculate the increase in mass of the flask as percentage of the mass of the material taken for the test.

B-5.3 Calculation

$$\text{Non-graphitic carbon, percent by mass} = 100 \frac{M_1 - M_2}{M} (A + B)$$

where

M_1 = first mass of the beaker and contents,
M_2 = second mass of the beaker and contents,
M = mass in g of the sample taken for the test,
A = percent loss on heating (*see* **B-2.1**), and
B = percent petroleum ether soluble matter.

AMENDMENT NO. 2 OCTOBER 1996
TO
IS 1305 : 1984 SPECIFICATION FOR GRAPHITE FOR USE IN FOUNDRY COATINGS

(Third Revision)

(*Page* 8, *clause* **B-5.3**) — Substitute the following for the existing:

'**B-5.3 Calculation**

$$\text{Non-graphitic carbon, percent by mass} = 100 \times \frac{(M_1 - M_2)}{M} - (A+B)$$

where

M_1 = first mass of the beaker and contents,

M_2 = second mass of the beaker and contents,

M = mass in g of the sample taken for test,

A = percent loss on heating (*see* **B-2.1**), and

B = percent petroleum ether soluble matter.'

(MTD 14)

Printed at Printograph, New Delhi (INDIA)

APPENDIX C

(*Clause* 6.1)

SAMPLING OF GRAPHITE

C-1. GENERAL REQUIREMENTS OF SAMPLING

C-1.0 In drawing, preparing, storing and handling test samples, the following precautions and directions shall be observed.

C-1.1 Samples shall not be taken in an exposed place.

C-1.2 The sampling instrument shall be clean and dry.

C-1.3 Precautions shall be taken to protect the samples, the material being supplied, the sampling instrument, and the containers for samples from adventitious contamination.

C-1.4 To draw a representative sample, the contents of each container selected for sampling shall be mixed as thoroughly as possible by suitable means.

C-1.5 The samples shall be placed in suitable, clean, dry and air-tight metal or glass containers.

C 1.6 The sample containers shall be of such a size that they are almost completely filled by the sample.

C-1.7 Each sample container shall be sealed air-tight by suitable means after filling and marked with full details of sampling, the date of sampling and the year of manufacture of the material.

C-1.8 Samples shall be stored in such a manner that the temperature of the material does not vary unduly from the normal temperature.

C-2. SCALE OF SAMPLING

C-2.1 Lot — In any consignment all the bags/packets of the material of the sample grade and drawn from the same batch of manufacture shall be grouped together to constitute a lot.

C-2.2 Tests for determination of the conformity of a lot to the requirements of the specification shall be done from each lot separately. The number of bags/packets to be selected at random for this purpose from a lot shall be in accordance with Table 4.

TABLE 4 SCALE OF SAMPLING

(*Clause* C-2.2)

No. of Bags/Packets in the Lot	No. of Bags/Packets to be Selected
Up to 50	3
51 ,, 100	4
101 ,, 300	5
301 ,, 500	7
501 and above	10

C-3. PREPARATION OF TEST SAMPLES

C-3.1 From each of the bags/packets selected according to **C-2.2**, small portions of the material shall be drawn with the help of a suitable sampling instrument from different parts of the bag/packet. The total quantity of the material so drawn from each bag/packet shall be not less than 500 g and these shall form the individual samples representative of the different bags/packets selected.

C-3.2 From each of the individual samples formed according to **C-3.1**, not less than 300 g of material shall be drawn and mixed together to form a composite sample. The composite sample so formed may be reduced further, if necessary, by coning and quartering so as to obtain enough material sufficient to conduct all the tests specified in the standard.

C-4. NUMBER OF TESTS

C-4.1 Tests for the determination of all the characteristics listed in Table 1 shall be conducted on each of the individual samples (*see* **C-3.1**).

C-4.2 Tests for the determination of fineness of the material as given in Table 2 shall be conducted on the composite sample (*see* **C-3.2**).

C-5. CRITERIA FOR CONFORMITY

C-5.1 The lot shall be declared as conforming to the requirements of the specification if the conditions stipulated in **C-5.1.1** and **C-5.1.2** are specified.

C-5.1.1 From the individual test results, the mean and the range shall be calculated wherever possible. (Range is defined as the difference between the maximum and minimum values of test results.)

C-5.1.2 For each of the characteristics listed in Table 1 the value of the corresponding expression (mean + 0·6 *range*) shall be found to be less than or equal to the relevant maximum value specified.

C-5.1.3 The test results for fineness of the material determined on the composite sample shall be found to be satisfactory as given in Table 3.

(*Continued from page* 2)

Members	*Representing*
Shri K. A. Gandhi	HMT Limited, Bangalore
Shri H. S. Ramachandra (*Alternate* I)	
Shri A. Shantharam (*Alternate* II)	
Shri P. P. Chopra (*Alternate* III)	
Shri P. M. Gokhale	Premier Automobiles Ltd, Bombay
Dr K. S. S. Murthy	Indian Institute of Science, Bangalore
Shri T. Ranganathan	Indian Vegetable Products, Bombay
Shri S. V. Maniar (*Alternate*)	
Shri S. C. Rastogi	Heavy Engineering Corporation Ltd, Ranchi
Shri M. Mohan (*Alternate*)	
Shri D. Sitaramiah	Greeves Foseco Ltd, Bombay
Shri S. Seetharaman (*Alternate*)	
Shri T. S. Venkoba Rao	Ennore Foundries Ltd, Madras
Shri K. Chinnathambi (*Alternate*)	

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mole

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radiam	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Ps	1 Pa = 1 N/m^2

BUREAU OF INDIAN STANDARDS

Headquarters
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones 323 0131, 323 3375, 323 9402
Fax 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams Manaksanstha
(Common to all Offices)

Central Laboratory	Telephone
Plot No 20/9, Site IV, Sahibabad Industrial Area, Sahibabad 201010	8-77 00 32
Regional Offices:	
Central Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern 1/14 CIT Scheme VII M, V I P Road, Maniktola, CALCUTTA 700054	337 86 6[illegible]
Northern SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
Southern C I T Campus, IV Cross Road, CHENNAI 600113	235 23 15
†Western Manakalaya, E9, Behind Marol Telephone Exchange, Andheri (East), MUMBAI 400093	832 92 95
Branch Offices::	
Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001	550 13 48
‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road, BANGALORE 560058	839 49 55
Gangotri Complex, 5th Floor, Bhadbhada Road, T T Nagar, BHOPAL 462003	55 40 21
Plot No 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001	40 36 27
Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No 43, Sector 16 A, Mathura Road, FARIDABAD 121001	8-28 88 01
Savitri Complex, 116 G T Road, GHAZIABAD 201001	8-71 19 96
53/5 Ward No 29, R G Barua Road, 5th By-lane, GUWAHATI 781003	54 11 37
5-8-56C, L N Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001	37 29 25
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001	23 89 23
NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010	52 51 71
Patliputra Industrial Estate, PATNA 800013	26 23 05
Institution of Engineers (India) Building 1332 Shivaji Nagar, PUNE 411005	32 36 35
T C No 14/1421, University P O Palayam, THIRUVANANTHAPURAM 695034	6 21 17

---

*Sales Office is at 5 Chowringhee Approach, P O Princep Street CALCUTTA 700072	27 10 85
†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007	309 65 28
‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002	222 39 71

Printed at Printograph, New Delhi, Ph 5726847